

# Quality of SCIAMACHY's radiometric calibration in the UV



Gijsbert Tilstra\*, Gijs van Soest, Piet Stammes

We investigate the quality of the radiometric calibration of SCIAMACHY in the ultraviolet, using a polarised radiative transfer code as a reference. A sensitivity study shows that in the UV, the reliability of the simulations is determined mostly by the input parameters of ozone profile (below ~330 nm) and surface albedo (above ~330 nm). This allows a comparison accuracy of 2–6%, depending on wavelength. The error in the radiometric calibration of SCIAMACHY is found to be 10–25%, again depending on wavelength.

## 1. Simulations

We focus on four regions of the Sahara desert, and calculate the SCIAMACHY reflectances in the wavelength range 240–400 nm.

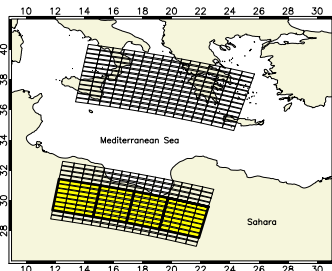


Figure A. Four Sahara regions observed by SCIAMACHY and simulated by DAK.

This reflectance is simulated using a polarised radiative transfer code (DAK). Proper input parameters are essential. What are the effects of errors in input parameters?

## 2. Sensitivity study

The sensitivity of the reflectance  $R$  to input parameter  $x$  is defined as:

$$dR_x / dx_x = (dR / R) / (dx / x)$$

### 2.1 Sensitivity to surface albedo

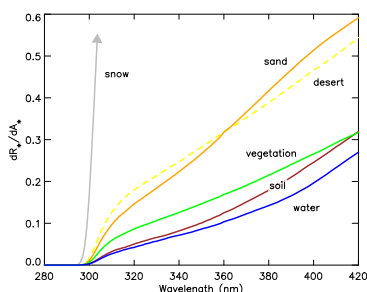


Figure B. Sensitivity of the reflectance to surface albedo for several surface types.

### 2.2 Sensitivity to ozone column

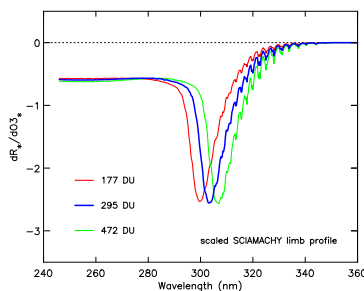


Figure C. Sensitivity of the reflectance to ozone column for three ozone columns.

### 2.3 Dependence on ozone profile

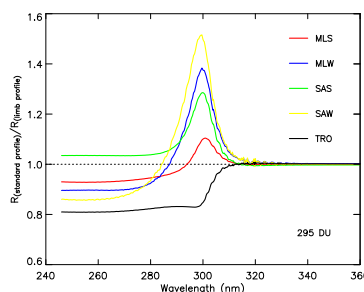


Figure D. Dependence of the reflectance on the shape of the ozone profile.

## 3. Radiometric error (UV)

Figure E shows the main result of the reflectance comparison for the four Sahara regions, and those of two other types of scenes. The quantity of interest is the relative difference  $d_R$  between SCIAMACHY and the radiative transfer code DAK, defined as:

$$d_R = (R_{\text{sciamachy}} - R_{\text{dak}}) / R_{\text{dak}}$$

A viewing-angle-dependency in  $d_R$  was not found, so the results were averaged over the four available regions (and viewing directions). Also shown are error curves, based on the sensitivity study and known accuracies in input parameters.

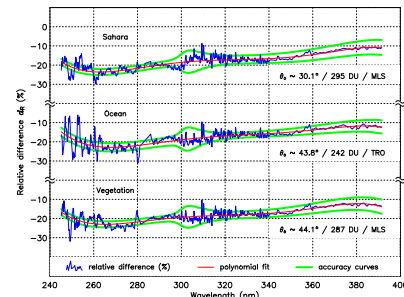


Figure E. Relative difference between the reflectance of SCIAMACHY and that of simulations, for three different scenes.

## 4. Radiometric error (visible)

Figure F shows the SCIAMACHY radiometric error in the visible and near-IR wavelength ranges, according to comparisons with other satellite instruments.

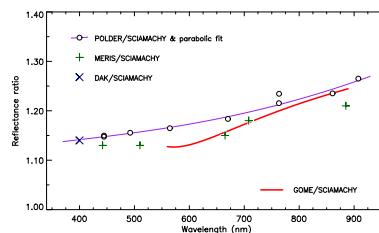


Figure F. Reflectance ratio in the visible wavelength range based on SCIAMACHY and simulations/other satellite instruments.

## 5. Conclusion

We studied the quality of the SCIAMACHY radiometric calibration in the UV (240–400 nm). Here the error in the reflectance calibration is 10–25%, depending on wavelength, but not on viewing angle. For the visible wavelength range, a similar error exists. The reflectance validation method we introduced can also be used for instruments like OMI, or GOME-2.

## References

- [1] L.G. Tilstra, G. van Soest, P. Stammes, "Method for in-flight satellite calibration in the UV using radiative transfer calculations, with application to SCIAMACHY", *J. Geophys. Res.* 110, doi:10.1029/2005JD005853, 2005.
- [2] J.R. Acarreta, P. Stammes, "Calibration comparison between SCIAMACHY and MERIS onboard ENVISAT", *IEEE Geosci. Remote Sens. Lett.* 2, 31–35, 2005.